

REMARKS

Figure 2 is objected to as having an unacceptable right margin. The figure is amended herein such that it is believed that it is now acceptable. Reconsideration of the objection to the drawings is requested.

Claims 1 through 8 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Manne in view of Hennessy. In view of the amendments to the claims and the following remarks, the rejections are respectfully traversed, and reconsideration of the rejections is requested.

The claims are amended to clarify the distinctions between the applicants' invention and the cited references. Specifically, the claims are amended to specify that the multiplexer for outputting either the conditional branch prediction or an inverted conditional branch prediction is controlled by a selection signal which is a predicted accuracy history signal, which is the most significant bit of the accuracy history bits of the invention stored in an accuracy history table. That is, the actual most significant bit of the accuracy history bits is applied to the selection control input of the multiplexer to select between the conditional branch prediction and the inverted conditional branch prediction.

In the applicants' invention, referring to Figure 2 of the application, the branch predictor of the invention generates both a predicted conditional branch I(Sc) and an inverted predicted conditional branch and applies them to a multiplexer 70. The selected output of the multiplexer 70 is controlled by a predicted accuracy history signal I(Ac). The predicted accuracy history signal I(Ac) is the same as the most significant bit (MSB) of corresponding accuracy history bits Ac stored in an accuracy history table 60. In accordance with the invention, the MSB of the accuracy history bits Ac is used directly to select the output from the multiplexer.

In accordance with the present invention, a second state transition logic 50 is composed of an up/down counter. The up/down counter increases the value of the accuracy history bits Ac by 1 in response to a comparison signal of logic "1" from a comparator 40. The comparison signal in this case indicates that the predicted conditional branch I(Sc) is the same as the real conditional branch Rc. In addition, the up/down counter decreases the value of the accuracy

history bits Ac by 1 in response to a comparison signal of logic "0" from the comparator 40. The comparison signal in this case indicates that the predicted conditional branch I(Sc) is different from the real conditional branch Rc.

In the invention, the counted value in the second state transition logic 50 is stored to the accuracy history table 60 as the accuracy history bits Ac. The MSB of the accuracy history bits Ac corresponding to the inputted branch prediction instruction is outputted as the predicted accuracy history signal I(Ac). The multiplexer 70 outputs the predicted conditional branch I(Sc) or the inverted predicted conditional branch, in response to the predicted accuracy history signal I(Ac).

In contrast, referring to Figure 1 and section 2.2 of the Manne reference, in Manne, each time a branch is predicted, a mass distance counter (MDC) value is compared to an inversion threshold. The MDC is incremented when a branch is correctly predicted, and it is reset to 0 otherwise. Upon comparison, if the MDC value is greater than or equal to the inversion threshold, then the branch is labeled high-confidence, otherwise, it is labeled low-confidence. If the branch is labeled low-confidence, the branch prediction is inverted, otherwise, it is not inverted. The inversion is selectively performed based on the result of the comparison. Thus, the Manne reference discloses a confidence estimator composed of the MDC for determining inversion of the branch prediction result, by comparing a counted value with the inversion threshold.

Manne neither teaches nor suggests the characteristics of the present invention set forth in the amended claims. Specifically, Manne neither teaches nor suggests forming an accuracy history table 60 for output control of a multiplexer using the MSB of corresponding accuracy history bits stored in the accuracy history table 60. That is, in the present invention, a predicted conditional branch I(Sc) having a value of "1" or "0" in response to an MSB of pattern history bits Sc is generated without comparison. The branch predictor generates and applies both an inverted predicted conditional branch and the predicted conditional branch I(Sc) to the multiplexer 70. One of the applied signals is selected directly by the MSB of the accuracy history bits Ac. In contrast, in Manne, a branch predictor performs branch prediction by

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comparing the branch prediction counter with a prediction threshold. The prediction result in the Manne system is inverted selectively, based on the result of the comparison from the confidence estimator. That is, Manne fails to teach or suggests the applicants' claimed approach to selecting a final branch prediction outcome as either a conditional branch prediction or the inverted conditional branch prediction.

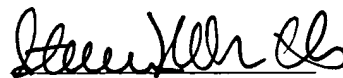
Hennessy is cited as teaching the use of a multiplexer. However, Hennessy does not teach or suggest the branch predictor set forth in the amended claims. That is, specifically, Hennessy fails to teach or suggest an accuracy history table containing accuracy history bits, the most significant bit of which being applied as the selection control input to a multiplexer, the multiplexer using the applied accuracy history bit to select between a conditional branch prediction and an inverted conditional branch prediction.

Since neither Manne nor Hennessy teaches or suggests the invention set forth in the amended claims, there is no combination of the references which would result in such teaching or suggestion. Since neither reference, taken alone or in combination, teaches or suggests the invention set forth in the amended claims, it is believed that the claims are allowable over the cited references. Accordingly, reconsideration of the rejections of claims 1 through 8 under 35 U.S.C. § 103(a) based on Manne and Hennessy is respectfully requested.

In view of the amendments to the claims and the foregoing remarks, it is believed that all claims pending in the application are in condition for allowance, and such allowance is respectfully solicited. If a telephone conference will expedite prosecution of the application, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

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